REMARKS

Claims 1, 3, 5-7, 9, 18-21 and 24-30 are now pending in the application. Claims 2, 4, 8, 10-17, 22 and 23 have been canceled. Claims 1, 3, 5, 6, 7, 9, 20 and 24 have been amended. Claims 29 and 30 are new. The amendments to the claims contained herein are of equivalent scope as originally filed and, thus, are not narrowing amendments. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

Claims 1-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shirota '107 or Ito '368 in view of Takasaki '578 and Hermann (Fig. 6).

Applicant would like to thank Examiner Ford for the courtesies afforded Applicant's representative during the personal interview on February 9, 2001. During the interview, agreement was not reached, but the Examiner indicated that by defining the shape of the region below the heat exchanger and adding additional language regarding condensation flow, it may be possible to distinguish over the cited prior art.

Claim 1 of the present invention has been amended to define the cooling heat exchanger as being inclined from a horizontal position to define an upper and lower end. The lower end of the cooling heat exchanger is defined as being spaced from the bottom portion of the case. Condensation occurring on the pipes is defined as flowing from the upper end to the lower end and then falling from the tubes due to gravity. Thus, Applicant has attempted to add the limitations proposed by the Examiner.

Shirota et al. and Ito et al. teach that the air-introducing direction into a lower space under the evaporator is designed to be in the same direction as the tubes and condensation is pushed by the blown air to the lower end of the evaporator. This is shown in Figures 8A and 8B of Shirota and Figures 6A and 6B of the present application. In these examples, condensed water generated in the evaporator 21 moves on the surface of the tubes 21a toward an inclination lower end portion C of the evaporator 21 due to gravity acting on the condensed water and pressure of the blown air. (See Figures 6A and 6B).

In the present invention in amended Claim 1, the air-introduction direction for introducing air to the lower space under the evaporator is perpendicular to the inclination direction of the evaporator and perpendicular to the longitudinal direction of the pipes. (See Figures 5A and 5B). This orientation significantly improves the draining performance of condensed water.

Enclosed is a reference Figure which illustrates the improvement in condensation flow of the present invention. In the reference figure, the broken line illustrates an evaporator like Shirota and Ito where the air flow is parallel to the tubes. The solid line illustrates an evaporator like the present invention where the air flow is perpendicular to the tubes. The reference figure shows a relationship between the limit air amount generating water scattering and the evaporator inclination angle. As the limit air amount generating water scattering becomes larger, water holding amount of the evaporator becomes smaller and the draining performance of the evaporator is improved. As can be seen from the reference figure, the draining performance of the present invention is significantly improved over that of a system like Shirota and Ito.

(Perpendicular air flow versus parallel air flow). Thus, while it initially would think logical to have the air flow parallel to the tubes to push the condensation down the tubes, the present invention goes against this teaching and has the air perpendicular to the tubes and this perpendicular orientation actually improves the condensation flow.

Takasaki et al. uses a vertical evaporator. In the vertical evaporator, as shown in Figure 1 of Takasaki, a drain pipe 41 is provided at a case bottom at a down stream air side of the evaporator because condensed water is forced through the evaporator by air pressure. That is, because air flows approximately horizontally, there is nothing in Takasaki that addresses the problem where condensed water is forced upwardly through the evaporator which is the problem being addressed by the present invention as detailed on pages 2, line 25 to page 3, line 16.

This, Applicant believes Claim 1, as amended, patentably distinguishes over the art of record. Likewise, Claims 3, 5-7, 9, 18-21 and 24-28, which ultimately depend from Claim 1 are also believed to patentably distinguish over the art of record. Claims 2, 4, 8, 10-17, 22 and 23 have been canceled. Reconsideration of the rejection is respectfully requested.

NEW CLAIMS

New Claims 29 and 30 are new independent claims. Claim 29 includes limitations regarding the high pressure area within the lower space. Claim 30 includes the limitations of condensation flow from Claim 1 and the high pressure area of Claim 29.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: April 11, 2001

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ATTACHMENT FOR CLAIM AMENDMENTS

The following is a marked up version of each amended claim in which underlines indicates insertions and brackets indicate deletions.

1. (Three Times Amended) An air conditioning apparatus for a vehicle having a passenger compartment, said air conditioning apparatus comprising:

a case forming an air passage, said case defining a bottom portion; and

a cooling heat exchanger for cooling air passing therethrough, disposed in said case, wherein:

said cooling heat exchanger has a plurality tubes extending in a longitudinal direction, through which a fluid flows;

said cooling heat exchanger is disposed in said case to be inclined from a horizontal direction by a predetermined angle to define an upper end and a lower end so that air is introduced into said cooling heat exchanger from below and flows upwardly, [and] said lower end of said cooling heat exchanger being spaced from said bottom portion of said case to form a lower space under said cooling heat exchanger;

said cooling heat exchanger is inclined in the same direction as the longitudinal direction of said tubes so that one end of said tubes in the longitudinal direction becomes lower than the other end of said tubes in the longitudinal direction, condensation occurring on said tubes flowing from said upper end of said heat exchanger to said lower end of said heat exchanger, said condensation falling from said tubes to said bottom portion due to gravity; and

said cooling heat exchanger is disposed so that a flow direction of air flowing into said lower space under said cooling heat exchanger is generally parallel to said cooling heat exchanger and approximately perpendicular to the longitudinal direction of said tubes.

3. (Amended) The air conditioning apparatus according to Claim [2] 1, wherein:

said cooling heat exchanger includes a tank portion for distributing fluid into said tubes and for joining fluid from said tubes, said tank portion being provided at least on one end side of each tube in the longitudinal direction;

said tank portion includes a joint portion having an inlet for introducing fluid into said cooling heat exchanger and an outlet for discharging fluid from said cooling heat exchanger[; and

said joint portion is disposed on an end surface of said tank portion in the vehicle width direction].

5. (Amended) The air conditioning apparatus according to Claim [4] 1, wherein:

[said case has a bottom surface portion on a lower side of said cooling heat exchanger;]

said bottom [surface] portion is inclined to correspond to said cooling heat exchanger [so that a vehicle front side of said bottom surface portion becomes higher than a vehicle rear side thereof]; and

said case has a drain hole for draining condensed water generated in said cooling heat exchanger, at a lowest position of said bottom [surface] portion.

6. (Amended) The air conditioning apparatus according to Claim 5, wherein:

said case has an air inlet through which air blown by said blower unit flows into the lower side of said cooling heat exchanger in said flow direction; and

said air inlet is formed between said cooling heat exchanger and said bottom [surface] portion along each inclination of said cooling heat exchanger and said bottom [surface] portion.

7. (Amended) The air conditioning apparatus according to Claim 1, further comprising:

a heating heat exchanger for heating air from said cooling heat exchanger, said heating heat exchanger being disposed on an upper side of said cooling heat exchanger [at a vehicle front side] so that a bypass passage through which air bypasses said heating heat exchanger is formed [at a vehicle rear side of said heating heat exchanger]; and

an air mixing door, disposed between said cooling heat exchanger and said heating heat exchanger, for adjusting a ratio between an amount of air passing through said heating heat exchanger and an amount of air passing through said bypass passage[,

wherein said case has a face opening portion for blowing air toward an upper side of the passenger compartment, at a vehicle rear side on an upper portion of said case].

9. (Amended) The air conditioning apparatus according to Claim [8, wherein:] 1, further comprising:

a blower unit for blowing air into said case, wherein:

said [air conditioning unit] case is adapted to be disposed at a center portion on a front side of the passenger compartment; and

said blower unit is [disposed] adapted to be shifted from said [air conditioning unit at a side] case in the vehicle width direction.

20. (Amended) The air conditioning apparatus according to any one of Claim 19, wherein said inside/outside air switching unit is adapted to be disposed at a vehicle front side of said blower in a vehicle front-rear direction.

24. (Amended) The air conditioning apparatus according to Claim [15] 19 wherein the rotation axis of said blower is [approximately] adapted to be in the vehicle front-rear direction.

Reference Figure